Document title: **Waste Removal Capability for the LAW Vitrification Facility**

Contract number: DE-AC27-01RV14136

Department: Process and Mechanical Systems

Author(s): R. Hanson

ISSUED BY
RPP-WTP PDC

Principal author signature:

Document number: 24590-LAW-PER-M-05-001, Rev 0

Checked by: L. Han

Checker signature:

Date of issue: 5/6/06

Issue status: Issued for Permitting Use

Approved by: J. Roth

Approver's position: Area Project Engineering Manager

Approver signature:

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED
PROFESSIONAL ENGINEER

5/4/06

EXPIRES: 07/28/07

This bound document contains a total of 13 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	05/06/06	Issued For Permitting Use	R. Hanson

Contents

Acronyms

AEA	Atomic Energy Act of 1954
C3/C5	Contamination Zones
DOE	US Department of Energy
LAW	Low Activity Waste
LCP	LAW Concentrate Receipt Process
LFP	LAW Melter Feed Process
LOP	LAW Primary Offgas Process
PTF	Pretreatment Facility
PWD	Plant Wash and Disposal
RLD	Radioactive Liquid Disposal
SBS	Submerged Bed Scrubber
WAC	Washington Administrative Code
WESP	Wet Electrostatic Precipitator

1 Summary

The Low Activity Waste (LAW) Vitrification Facility must satisfy the waste removal criteria of Washington Administrative Code 173-303-640(4) and of Dangerous Waste Permit Number WA7890008967 (Ref. 2), Permit Condition III.10.E.9.e.iii and III.10.H.5.e.iii for LAW Vitrification facility tank and miscellaneous treatment unit, secondary containment systems. This report evaluates the capability for removing, within 24 hours, leaked waste that may accumulate within the regulated process cells within the LAW facility.

The secondary containment areas located at the (-) 21 feet and +3 feet elevations of the LAW facility are provided with sumps. The secondary containment areas within the LAW facility are stainless steel lined. The liners are sloped to direct liquids to dry sumps in the cells. The sumps within the building are emptied by submersible electric sump pumps that can transfer accumulated liquids to process vessels for storage and subsequent processing. The levels in the sumps are detected by radar type level detectors.

Waste removal capability is estimated for four containment areas listed as follows:

1. Room L-B001B, C3/C5 Drain Collection Cell, -21 ft Elevation. The C3/C5 drain collection cell contains the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004). There are sprinklers in the cell. The vessel total volume is 1034 ft^3 (Ref. 3) and the volume of in-cell sprinkler firewater system is 246 ft^3 (Ref. 3). Additionally, C3/C5 area firewater drains to this cell. The total firewater accumulation in the room from these drains is 2864 ft^3 (Ref. 3).
2. Room L-0123, Process Cell Melter 1, 3 ft Elevation. The process cell contains six vessels. The largest in the cell is the Melter 1 Concentrate Receipt Vessel (LCP-VSL-00001). The vessel total volume is 2428 ft^3 (Ref. 3). The room has no fire protection sprinklers.
3. Room L-0124, Process Cell Melter 2, 3 ft Elevation. The process cell contains six vessels. The largest in the cell is the Melter 2 Concentrate Receipt Vessel (LCP-VSL-00002). The vessel total volume is 2428 ft^3 (Ref. 3). The room has no fire protection sprinklers.
4. Room L-0126, Effluent Cell, 3 ft Elevation. The effluent cell contains two vessels the Plant Wash Vessel (RLD-VSL-00003) and the SBS Condensate Collection Vessel (RLD-VSL-00005), which are identical in size with a vessel total volume of 3445 ft^3 (Ref. 3). The room has no fire protection sprinklers.

The results of the evaluation of waste removal capacity for each of the containment areas is summarized as follows:

1. Room L-B001B, C3/C5 Drain Collection Cell, -21 ft Elevation. Waste removal is achieved by operation of one submersible electric pump in one sump. Total waste removal capacity is 11.9 hours for firewater drains from other C3/C5 areas and 5.3 hours for the vessel and in-cell firewater sprinklers.
2. Room L-0123, Process Cell Melter 1, 3 ft Elevation. Waste removal is achieved by operation of two submersible electric pumps in two sumps. Total waste removal capacity is 5.0 hours.
3. Room L-0124, Process Cell Melter 2, 3 ft Elevation. Waste removal is achieved by operation of two submersible electric pumps in two sumps. Total waste removal capacity is 5.0 hours

4. Room L-0126, Effluent Cell, 3 ft Elevation. Waste removal is achieved by operation of two submersible electric pumps in two sumps. Total waste removal capacity is 7.2 hours.

These values are within the 24-hour period required by the regulations and stipulated by Permit Condition III.10.E.9.e.iii and III.10.H.5.e.iii (Ref. 2). These values are based on consideration of the total operating volume of a single vessel in its respective containment area, plus the total anticipated volume of firewater (if applicable) that is postulated to accumulate in these cells.

2 Objective

The purpose of this report is to estimate and document the waste removal capabilities for the LAW process cells and other secondary containment areas associated with tank systems and miscellaneous unit systems. General guidance for scoping of this report is documented in Ref. 6.

The LAW Facility must satisfy the waste removal criteria of Dangerous Waste Permit Number WA7890008967, Permit Condition III.10.E.9.e.iii and III.10.H.5.e.iii (Ref. 2) for tank and miscellaneous treatment unit, secondary containment systems. This report evaluates the capability for removing, within 24 hours, leaked waste that may accumulate within the regulated process cells within the facility.

Excluded from the scope of this report are:

- Secondary containment areas where leaks flow directly (via drain systems) to collection tanks
- Transfer line containment systems
- Containment areas that do not include tank or miscellaneous unit systems, e.g., maintenance cells
- Process Cell Melter 3, Room L-0125.

3 Description

The regulatory requirements for the effluent vessel cells are contained in WAC 173-303-640, Tank Systems, Section 4, Containment and Detection of Releases (Ref. 1). The regulatory requirements are restated as follows:

> (b) Secondary containment must be:
>
> > "Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks spills or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within twenty-four hours, or in as timely a manner as is possible..." [WAC 173-303-640(4)(c)(iv)}.

In addition, the Waste Treatment Plant Dangerous Waste Permit (Ref. 2), Permit Condition III.10.E.9.e.iii and III.10.H.5.e.iii requires submittal of:

> "Detailed operational plans and descriptions, demonstrating that spilled or leaked waste and accumulated liquids can be removed from the secondary containment system within twenty-four (24) hours" [WAC 173-303-806(4)(c)(vii)]; [WAC 173-303-806(4)(i)(i)(B)

4 Assumptions

Assumptions used in this evaluation of LAW Facility waste removal capabilities are listed as follows.

1. Nominal design flow rates for sump pumps are used to estimate waste removal rates. Purchased equipment will have capacities equal to or exceeding the nominal design flow rates.

2. Operator response times needed for activating transfer pumps or time required for manual alignment of valves and pump priming are ignored for the purposes of this evaluation.

3. Waste removal rate is achieved by simultaneous operation of sump pumps within a waste containment area.

4. The activation of C3/C5 firewater sprinklers in other areas of the building does not occur at the same time as a leak of the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004).

5. The capacity to receive and store leaks removed from secondary containment areas is assumed to be available. Adequate space is available in Pretreatment Facility (PTF) vessels to contain the total estimated volume from a leak in the LAW Plant Wash Vessel RLD-VSL-00003. For postulated leaks from other LAW tanks, adequate space is available in RLD-VSL-00003 to contain the total estimated flooding volume for a single event or can be made available in RLD-VSL-00003 by pumping its contents to PTF from this vessel. Pretreatment Plant Wash Vessel (PWD-VSL-00044) has volume available, if required, within 24 hours or in as timely a manner as possible to receive liquid waste from LAW. Delays associated with drawing down liquid level in RLD-VSL-00003 to create adequate space and delays associated with sampling and analysis prior to initiating waste transfers to PTF, are not considered. If the leak cannot be removed from the secondary containment areas within 24 hours, Ecology will be notified and actions taken as required under permit conditions III.10.E.5.j and III.10.H.1.a.xxiv (Ref. 2).

5 Analysis

5.1 Room L-B001B, C3/C5 Drain Collection Cell, -21 ft Elevation

The room L-B001B, C3/C5 Drain Collection Cell is located on the north side of the LAW facility at the (-)21 ft elevation and is identified on the LAW facility general arrangement drawing (Ref. 4). It contains one vessel C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004). The cell floor and lower portions of the walls have stainless steel liners to provide secondary containment. The cell floor liner is sloped toward a low-point sump (RLD-SUMP-00028) with radar level detection and the sump has a submersible electric sump pump (RLD-PMP-00004) with a nominal flow rate of 30 gpm.

The flooding volume scenario is the failure of the vessel (RLD-VSL-00004) with a total volume of 1034 ft^3 with the in-cell sprinklers volume of 246 ft^3 in the containment area for a total 1280 ft^3, or the maximum postulated flood volume from firewater runoff from higher elevation drains (assumption 4) from other C3/C5 areas of 2864 ft^3 (Ref. 3).

Fluids from the cell sump are pumped by a submersible electric sump pump into the Plant Wash Vessel (RLD-VSL-00003) located at the 3 ft elevation and from there to the Pretreatment Plant Wash Vessel (PWD-VSL-00044) located at the 0 ft elevation in the PTF for subsequent processing.

5.2 Room L-0123, Process Cell Melter 1, 3 ft Elevation

Room L-0123, Process Cell Melter 1 is located in the center of the LAW facility at elevation 3 ft and is identified on the LAW facility general arrangement drawing (Ref. 5). It contains six vessels and associated pumps. The six vessels are:

- Melter 1 Concentrate Receipt Vessel (LCP-VSL-00001)
- Melter 1 Feed Preparation Vessel (LFP-VSL-00001)
- Melter 1 Feed Vessel (LFP-VSL-00002)
- Melter 1 Submerged Bed Scrubber (SBS) Condensate Vessel (LOP-VSL-00001)
- Melter 1 Wet Electrostatic Precipitator (WESP) (LOP-WESP-00001)
- Melter 1 Submerged Bed Scrubber (SBS) (LOP-SCB-00001).

A stainless steel liner provides secondary containment to accommodate the total volume of the largest vessel in the area, the Melter 1 Concentrate Receipt Vessel (LCP-VSL-00001), for a total flooding volume of 2428 ft^3 (Ref. 3). The room has no fire protection sprinklers.

The cell floor liner is sloped toward the low-point sumps RLD-SUMP-00029 and RLD-SUMP-00030, which are provided with radar level detection instruments and submersible electric sump pumps (RLD-PMP-00025 and RLD-PMP-00026) to remove the contained liquid. The pumps have a nominal design flow rate of 30 gpm. Fluid from the cell is pumped into the Plant Wash Vessel (RLD-VSL-00003) located at the 3 ft elevation and from there to the Pretreatment Plant Wash Vessel (PWD-VSL-00044) located at the 0 ft elevation in PTF for subsequent processing.

5.3 Room L-0124, Process Cell Melter 2, 3 ft Elevation

Room L-0124, Process Cell Melter 2 is located in the center of the LAW facility at elevation 3 ft and is identified on the LAW facility general arrangement drawing (Ref. 5). It contains six vessels and associated pumps. The six vessels are:

- Melter 2 Concentrate Receipt Vessel (LCP-VSL-00002)
- Melter 2 Feed Preparation Vessel (LFP-VSL-00003)
- Melter 2 Feed Vessel (LFP-VSL-00004)
- Melter 2 Submerged Bed Scrubber (SBS) Condensate Vessel (LOP-VSL-00002)
- Melter 2 Wet Electrostatic Precipitator (WESP) (LOP-WESP-00002)
- Melter 2 Submerged Bed Scrubber (SBS) (LOP-SCB-00002).

A stainless steel liner provides secondary containment to accommodate the total volume of the largest vessel in the area, the Melter 2 Concentrate Receipt Vessel (LCP-VSL-00002), for a total flooding volume of 2428 ft^3 (Ref. 3). The room has no fire protection sprinklers.

The cell floor liner is sloped toward the low-point sumps RLD-SUMP-00031 and RLD-SUMP-00032, which are provided with radar level detection instruments and submersible electric sump pumps (RLD-PMP-00027 and RLD-PMP-00028) to remove the contained liquid. The pumps have a nominal design flow rate of 30 gpm. Fluid from the cell is pumped into the Plant Wash Vessel (RLD-VSL-00003) located at the 3 ft elevation and from there to the Pretreatment Plant Wash Vessel (PWD-VSL-00044) located at the 0 ft elevation in PTF for subsequent processing.

5.4 Room L-0126, Effluent Cell, 3 ft Elevation

Room L-0126, Effluent Cell is located in the center of the LAW facility at elevation 3 ft and is identified on the LAW facility general arrangement drawing (Ref. 5). It contains two vessels and associated pumps. The two vessels are the Plant Wash Vessel (RLD-VSL-00003) and the SBS Condensate Collection Vessel (RLD-VSL-00005).

A stainless steel liner provides secondary containment to accommodate the total volume of the largest vessel in the area, either the Plant Wash Vessel (RLD-VSL-00003) or the SBS Condensate Collection Vessel (RLD-VSL-00005), for a total flooding volume of 3445 ft^3 (Ref. 3). The room has no fire protection sprinklers.

The cell floor liner is sloped toward the low-point sumps RLD-SUMP-00035 and RLD-SUMP-00036, which are provided with radar level detection instruments and submersible electric sump pumps (RLD-PMP-00031 and RLD-PMP-00032) to remove the contained liquid. The pumps have a nominal design flow rate of 30 gpm. Fluid from the cell is pumped into the Plant Wash Vessel (RLD-VSL-00003) located at the 3 ft elevation and from there to the Pretreatment Plant Wash Vessel (PWD-VSL-00044) located at the 0 ft elevation in PTF for subsequent processing.

The Plant Wash Vessel (RLD-VSL-00003) also has the ability to pump to SBS Condensate Collection Vessel (RLD-VSL-00005) and SBS Condensate Collection Vessel has the ability to pump to the Pretreatment Plant Wash Vessel (PWD-VSL-00044). The Plant Wash Vessel pumps (RLD-PMP-00001A/B) and the SBS Condensate Collection Vessel discharge pumps (RLD-PMP-00003A/B) have a nominal capacity of 175 gpm. Pretreatment Plant Wash Vessel (PWD-VSL-00044) has volume available, if required, within 24 hours or in as timely a manner as possible (Assumption 5).

6 Sump Removal Rates

The results of this evaluation are compiled in the table below based on calculations provided in Section 7.

LAW Facility
Waste Removal Capacity Over 24 Hours

Containment Area Elevation	Containment Area Room Number	Sump Number	Sump Waste Removal Capacity, (US gal/h)	Largest Vessel in Containment Area (Vessel Number and Total Volume)	Largest Vessel Waste Removal Capacity[1], h	Fire Water Volume[2]. (US gal)	Fire Water Removal Capacity[1], h	Total Flooding Volume (US gal)	Total Containment Area Waste Removal Capacity[1], h
-21	L-B001B	RLD-SUMP-00028	1800	RLD-VSL-00004, 7734 gal	4.3	1840	1.0	9574	5.3
-21	L-B001B	RLD-SUMP-00028	1800	NA See Assumption 4	NA	21,423	11.9	21,423	11.9
3	L-0123	RLD-SUMP-00029 RLD-SUMP-00030	3600	LCP-VSL-00001, 18,161gal	5.0	Not applicable. Firewater is not collected in this containment area.		18,161	5.0
3	L-0124	RLD-SUMP-00031 RLD-SUMP-00032	3600	LCP-VSL-00002, 18,161 gal	5.0	Not applicable. Firewater is not collected in this containment area.		18,161	5.0
3	L-0126	RLD-SUMP-00035 RLD-SUMP-00036	3600	RLD-VSL-00005, 25,769	7.2	Not applicable. Firewater is not collected in this containment area.		25,769	7.2

[1] Waste removal capacity is based upon the combined sump removal capacity of all sumps in the containment area.
[2] Firewater volume derived from flooding volume report (Ref. 3)

7 Bounding Calculations

Waste removal capability is estimated for four containment areas based on the bounding calculations presented in this section. The four containment areas are listed as follows:

1. Room L-B001B
2. Room L-0123
3. Room L-0124
4. Room L-0126

7.1 Room L-B001B, C3/C5 Drain Collection Cell, -21 ft Elevation

This containment area contains one vessel, C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004). The total volume of the vessel is 1034 ft^3 (Ref. 3). The in-cell firewater is 246 ft^3 (Ref. 3). The volume of firewater from other elevations is 2864 ft^3 gallons (Ref. 3). The activation of C3/C5 firewater sprinklers in other areas of the building does not occur at the same time as a leak of the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)(assumption 4). A evaluation is provide for both scenarios below.

Total vessel volume = 1034 ft^3 x 7.48 gallons/ft^3 = 7734 gallons
In-cell firewater = 246 ft^3 x 7.48 gallons/ft^3 = 1840 gallons

Volume of fire water from other elevations = 2864 ft^3 x 7.48 gallons/ft^3 = 21,423 gallons

The sump in this containment area contains one submersible electric sump pump with a nominal design capacity of 30 gpm. The capacity in gallons/hr is:

Pump capacity = 30 gpm x 60 min/hr = 1,800 gal/hr

Waste removal capacity for the largest vessel is:

Vessel removal capacity = 7734 gal/1,800 gal/hr = 4.3 hours

Waste removal capacity for the firewater is:

Fire water removal capacity = 1840 gal/1,800 gal/hr = 1.0 hours

Total containment area waste removal capacity is 4.3 hours + 1.0 hours = 5.3 hours

Waste removal capacity for the firewater from other elevations is:

Fire water removal capacity = 21,423 gal/1,800 gal/hr = 11.9 hours

7.2 Room L-0123

This containment area contains six vessels. The flooding volume 2428 ft^3 (Ref. 3) is based on the total volume of the largest vessel in this area Melter 1 Concentrate Receipt Vessel (LCP-VSL-00001). There is no firewater discharge in this containment area.

Total volume of largest vessel = 2428 ft^3 x 7.48 gallons/ft^3 = 18,161 gallons

The containment area contains two sumps each with a submersible electric sump pump that have a nominal design capacity of 30 gpm. Converting to gal/hr.

Pump capacity = 2 x 30 gpm x 60 min/hr = 3,600 gal/hr

Waste removal capacities are then calculated as follows:

Vessel removal capacity = 18,161 gal/3,600 gal/hr = 5.0 hr

7.3 Room L-0124

This containment area contains six vessels. The flooding volume 2428 ft^3 (Ref. 3) is based on the total volume of the largest vessel in this area Melter 2 Concentrate Receipt Vessel (LCP-VSL-00002). There is no firewater discharge in this containment area.

Total volume of largest vessel = 2428 ft^3 x 7.48 gallons/ft^3 = 18,161 gallons

The containment area contains two sumps each with a submersible electric sump pump that have a nominal design capacity of 30 gpm. Converting to gal/hr.

Pump capacity = 2 x 30 gpm x 60 min/hr = 3,600 gal/hr

Waste removal capacities are then calculated as follows:

Vessel removal capacity = 18,161 gal/3,600 gal/hr = 5.0 hr

7.4 Room L-0126

This containment area contains two vessels. The flooding volume 3445 ft^3 (Ref. 3) is based on the total volume of the largest vessel in this area either the Plant Wash Vessel (RLD-VSL-00003) or the SBS Condensate Collection Vessel (RLD-VSL-00005). There is no firewater discharge in this containment area.

Total volume of largest vessel = 3445 ft^3 x 7.48 gallons/ft^3 = 25,769 gallons
The containment area contains two sumps each with a submersible electric sump pump that have a nominal design capacity of 30 gpm. Converting to gal/hr.

Pump capacity = 2 x 30 gpm x 60 min/hr = 3,600 gal/hr

Waste removal capacities are then calculated as follows:

Vessel removal capacity = 25,769 gal/3,600 gal/hr = 7.2 hr

8 References

1. WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code.
2. WA 7890008967, *Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Chapter 10 and Attachment 51, "Waste Treatment and Immobilization Plant."
3. 24590-LAW-PER-M-02-002, Appendix A, Rev. 6, Flooding Volume for LAW Facility
4. 24590-LAW-P1-P01T-P0001, Rev 2, LAW Vitrification General Arrangement Plan at EL (-) 21'-0"
5. 24590-LAW-P1-P01T-P0002, Rev 3, LAW Vitrification General Arrangement Plan at EL 3'-0"
6. CCN 097900, Waste Removal Capability Scoping Document, 8/20/2004